Space Weather Technical Forecast

Issued on Monday, 18 July 2022 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1-R2 Likely and Active electron fluence expected initially. Chance G1 from CME arrival 19 or 20 July.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low over the last 24 hours, with a background of C-class flares. There are 7 sunspot regions on the visible disc, with AR3055 (Eho/Beta-Gamma) and AR3058 (Beta-Gamma-Delta) the two most complex regions. Most of the remaining regions are relative benign bi-polar spots, which have not shown much development over the last 24 hours. There is also a very simple alpha region. There were a number of CME leaving the Sun in the last 24 hours, but these have been analysed, with no new Earth-directed CMEs forecast.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, has been steadily declining through the last 24 hours from 550km/s to 400km/s as the recent high speed stream, possibly from coronal hole 99, wanes to background levels. Density has been around average throughout the period. Total magnetic field strength was weak, with a brief spike to moderate levels at 18/1042UTC. The north-south component, Bz, weakly oscillated between positive and negative directions, but with a slightly increasing amplitude. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, was at Background levels. High energy electron flux was above the high (1e3pfu threshold through much of the period, peaking at 5270pfu at 17/1830UTC, but then decreased to mainly moderate levels from 18/0555UTC. The 24-hour integrated electron fluence remained above the Active (1e8 integrated pfu) threshold, with a rising trend and an observed value at 18/0001UTC of 2.61e8 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is likely to be moderate with a number of significant sunspot regions on the visible disc. There is a slight chance of High solar activity.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 15 July, is forecast to arrive at Earth either late on 19 or early on 20 July, with a chance of G1/Minor Storms. A small coronal hole may also connect with the Earth on 19 July, although this is likely to be masked by any CME arrival. A further coronal hole connection is then forecast for day 4 (21 July). Geomagnetic activity should be most reliably Quiet on day 1, 18 July, rising to a Chance of G1 on 19 and 20 July, fading to a Slight Chance on 21 July.

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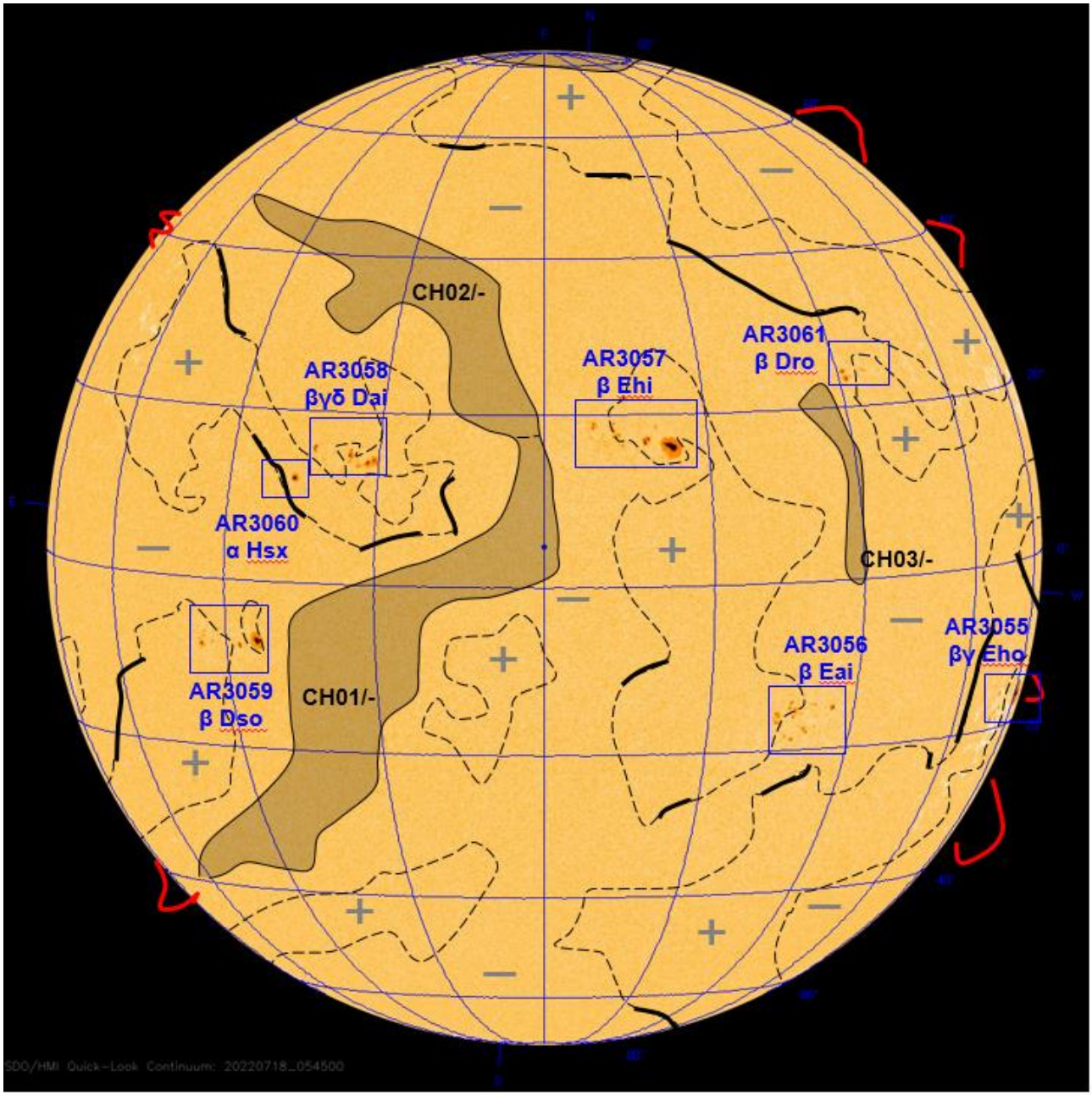
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, but with a daily slight chance of S1 or greater due to the presence of large sunspot regions in the west or near centre-disc. Electron flux is likely to remain at mainly moderate, occasionally high levels through days 1 to 3, due to any geomagnetic enhancements, with a chance of a trend to persistently high levels on day 4. Fluence levels above the Active (1e8 integrated pfu) threshold are likely to remain until day 2 when any geomagnetic enhancement and declines in the flux are likely to lead to a sharp decline in the fluence.

Figure 1. Solar Analysis Valid 18/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one Earth-directed CME in the forecast period from a filament eruption which let the Sun on 15 July. This is due to arrive at Earth late on 19 July, UTC, with a low probability of an arrival on 20 July.

Coronal hole 03 is due to connect with the Earth on 20 July, although the connection could be masked by the forecast CME arrival. The next significant connection is then forecast from the trans-equatorial coronal holes 01 and 02 which could connect on day 4 (21 July). Speeds of 500km/s are possible from these features based on observations from STEREO A.

Geomagnetic activity is expected to be mainly Quiet today. A chance of G1/Minor Storms on day 2 and perhaps day 3 (19 and 20 July). A further risk of Active or G1/Minor Storms on day 4, due to the forecast coronal hole connection.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	40	40	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0209	Partial	Filament eruption	NW quadrant	395 km/s	19/2359 UTC +/- 9 hours	Partial halo with main ejecta ahead of Earth

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Figure 2: MOSWOC Enlil forecast showing expected time of CME arrival

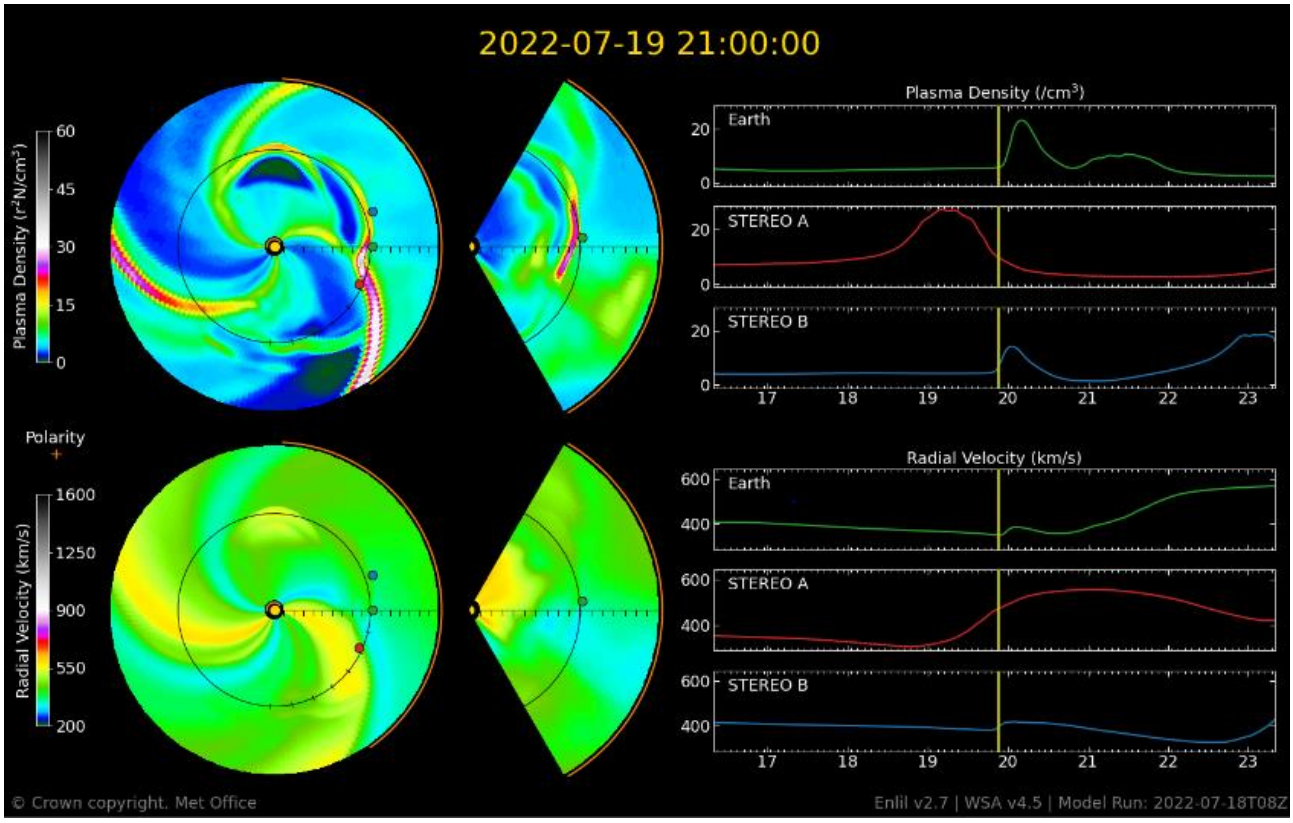
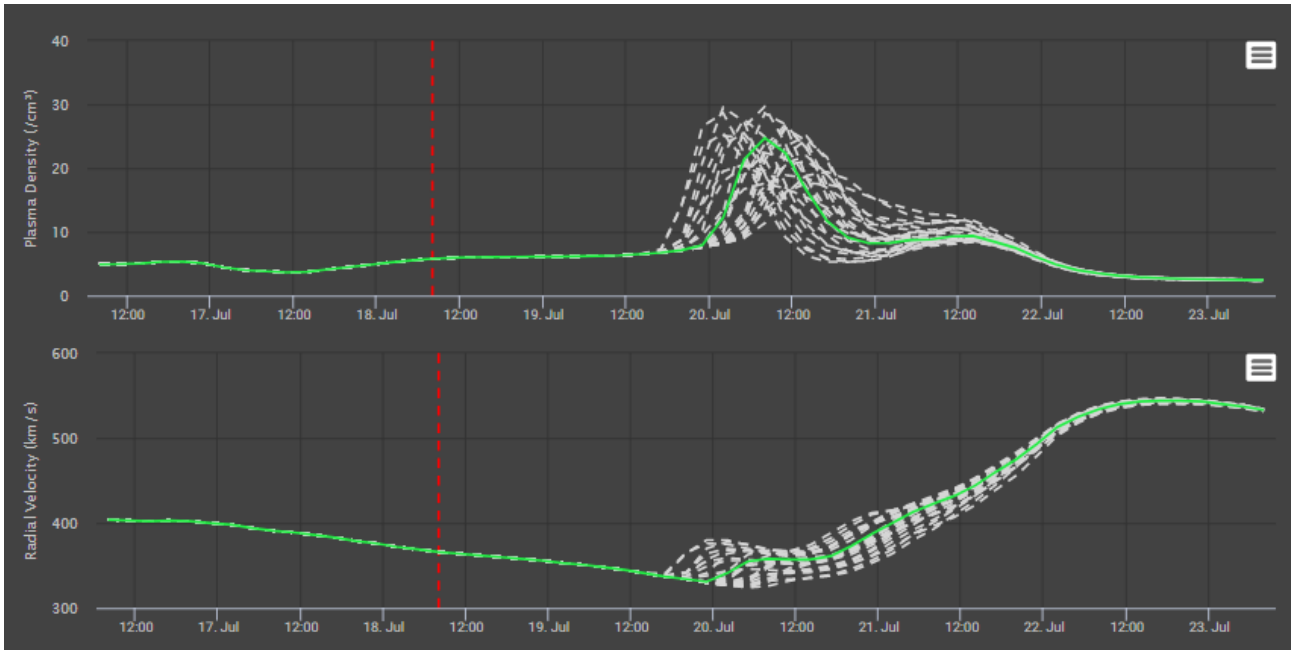


Figure 2: MOSWOC Enlil ensemble, showing potential range of arrival times



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Radio Blackouts - X-Ray Flares:

Solar activity has been Low. There are a number of large regions on the visible disc, with AR3055 (Eho/Beta-Gamma) and AR3058 (Beta-Gamma-Delta) the most magnetically complex. AR3055 is due to rotate off the disc in the next 24 hours with a consequent reduction in risk, although any flares from this region would still be visible from over the solar horizon. This should keep the risk of M-class flaring fairly constant through the period.

There is therefore a likelihood of M-class flares and a slight chance of X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	50	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels.

Owing to the complexity of the current disc, and in particular several large regions in the west or near centre-disc, there is a daily slight chance of S1 or greater occurring. However, none of the present Earth-facing sunspots have any history of generating any flare-tied proton enhancements.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux has dropped below the high (1e3pfu) threshold following a consistent period. This may be due to the waning high speed stream, as geomagnetic activity is currently Quiet. The trend through the next three days is likely to be suppressed values initially on days 1 due to geomagnetic activity, followed by an increasing trend on days 3 and 4 due to the input into the belts due to the forecast high speed streams. There is however a slight chance that geomagnetic activity could be more muted, leading to a quicker increase in electron flux values.

Electron flux values are forecast to decline through days 1 to 3, due to the anticipated geomagnetic activity and potential suppression of electron flux. This may take the electron fluence value close to or slightly below the Active (1e8 integrated pfu) threshold, although the magnitude of this decrease is strong dependent on the level of geomagnetic activity.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	Yes	100	70	40	20
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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